faint traces of slightly darker lines crossing the wing from these dorsal spots can with difficulty be discerned in certain lights. Cilia dark golden yellow. Hindwings light fuscous with ochreous fuscous cilia. Abdomen dark fuscous above golden yellow on the underside. Legs golden yellow. Venation typical: Forewings with 7 and 8 stalked. Alar expanse: 13–14 mm.

Habitat: Ashland, Ore., P. D. Serpent, collector.
Type: Cat. No. 20114, U. S. N. M.
Bred from Incense Cedar, *Libocedrus decurrens.*
Nearest to the Eastern *A. alternatella* Kearfott, but larger and deeper in color and without the conspicuous mottling of that species.

Argyresthia furcatella, new species.

Palpi, face, head and thorax white. Forewings white, sprinkled with dark brown transverse reticulations especially toward the apex; from the middle of the dorsum runs an illdefined outwardly oblique, dark brown fascia to beyond the end of the cell, but does not quite attain costa; on the fold between this and the base is a small round dark brown spot; a series of dark brown marginal spots begin on the middle of costa and reach round to tornus. Veins 7 and 8 stalked. Cilia dark ochreous fuscous. Hindwings ochreous fuscous. Abdomen silvery fuscous. Legs white with dark brown annulations at the tip of all the joints. Venation typical. Alar expanse: 12–13 mm.

Habitat: Cheyenne Canon, Colo.
Type: Cat. No. 20207, U. S. N. M.
Bred by Mr. A. B. Champlain from cynipid gall on Oak.
Nearest to *Argyresthia pedmontella* Chambers and *rileiella* Busck, differing in details of ornamentation, especially by the presence of the round dark spot on the fold, and by having veins 7 and 8 in the forewings stalked.

ON THE TAXONOMIC VALUE OF SOME LARVAL CHARACTERS IN THE LEPIDOPTERA.[1]

By Carl Heinrich, *Specialist in Forest Lepidoptera.*

It is not proposed in this paper to enter upon a discussion of all the characters that have been used to distinguish larvae, but merely to consider certain head characters which are particularly valuable for defining generic limits and determining immediate family relationships within the so-called Microlepidoptera.

[1] Contribution from the Division of Forest Insects, Bureau of Entomology.

In studying the head we find that while under different conditions of environment it assumes a multitude of different shapes and is variously modified in the proportionate development of its organs and parts, that such changes are frequently more superficial than fundamental. Certain characters still persist in their typical form through most of the changes. Even when there is a radical and fundamental alteration in structure due to the same environmental stimulus the forms differ in groups of different origin. The best examples of this are found among the leaf and bark mining larvae that have become adapted to sap-feeding (Comp. Tragardh (8)). The flat heads of all the Gracelariidae conform to one general family type while those of *Phyllocnistis* modified in the same organs and to the same purpose, exhibit a quite different form. Among the tissue feeding miners the differences are also striking. *Ectoedemia* and *Opostega*, for example, inhabit flat serpentine mines and have the head similarly depressed but differ in fundamental structure.

The generic and larger group characters of the head are found in the shape and proportions of the head capsules, the character of the frons, the setae and the trophi. Color and color markings are at most of specific importance. Very often they vary in individuals, or in different stages of the same larva. The shape and intensity of pigmentation in the ocellar area is also variable, being often unevenly distributed on opposite sides of the same head.

HEAD CAPSULE.

The general shape of the head capsule is a character that must be used with considerable caution. By itself and unsupported by other characters it is worthless in many groups. In certain specialized families and subfamilies it is diagnostic. The rounded, caudally-extended and widely separated blade-like dorsal hind margins of the epicranium are typical of the Nepticulidæ. *Mnemonica* and *Dorata* have projections resembling these but much longer, differently shaped and closer at the extremities. The horse-shoe shaped head of *Tischeria* and the wedge-like heads of the flat gracilariids are characteristic. On the other hand, the free-feeding Micros have much the same type of head. There is, for example, little or nothing in the general shape to distinguish a gelechiid from a tortricid or a phycid. Taken together with other characters, however, peculiarities of shape are significant and constant within a genus. The general shape and proportions of the head capsule should be noted in larval descriptions. In our joint paper (7) on *A. strigifinitella*, Fr. DeGryse and the writer have designated the line of greatest width as the norm of comparison in expressing proportions of the head capsule. This is a purely

arbitrary method but it has the advantage that, by stating where the greatest width lies and then defining other dimensions in its terms, one is able to describe the shape and proportions in brief formula.

THE FRONS.

The shape and dimensions of the frons and its adfrontal margins are characters of greater value and have been extensively used by Dyar in his numerous descriptions, and by both Forbes (5) and Fracker (6) in their diagnosis of families. The frons and adfrons are usually treated as separate sclerites. In reality frons and adfrons are, as has been shown by Dampf (2), one piece, the only suture being between the adfrons and epicranium, the line marking the division of frons and adfrons being merely an infolding. The extent of this infolding varies considerably in different forms. In the normal head of free-feeding larvae the external portion of the adfrons is appreciable, and narrowly borders the frons, the greater portion being folded in to form a strong chitinous, caudally pointed arch within the head. The points (Plate X, fig. 1) where the frontal margins begin to converge sharply to make the V-like line, indicate the attachment of the tentorial arms. In sap-feeding larvae the frons is considerably widened and extends back to the vertex of the head with little or no narrowing. In these forms the infolding is greatly reduced and the adfrontal margins absent. The points of attachment of the tentorial arms are thrust correspondingly far back with a bridge between them, connecting the dorsal hind margins of the epicranium. In *Mnemonica* [Comp. Busck and Boring (1)], on the other hand, there is but a slight infolding to mark the lines of a rather normal frons, and little or no reduction of the sclerite, the adfrontal margins being extended until they form a half circle covering a greater part of the anterior dorsal surface of the head capsule. Such skeletal modifications are necessitated by the environment and biology of the larvae. Their degree would indicate therefor, the extent to which any particular form had developed to meet a given condition, but in spite of the fact that a similar biology will produce similar modifications, the different fundamental form of the head structure remains distinguishable.

A *Cameraria* and a *Phyllocnistis* rise to practically the same level of development from different starting places. Their environment has caused similar modifications, but the type form remains different.

There is an internal cause for certain changes in the frontal sclerite as well as the external one of alteration to accommodate the larva to any particular mining habit, and that is the increase or decrease of muscular tension at their points of attachment.

The frons, with its strong infoldings, forms a bridge supporting the head against the thrust of the mandibles and the pull of the strong adductor mandibular muscles attached to the infolded portions of the epicranium forming the adfrontal suture (the straight line of the Y). In the forms which have only to tear delicate leaf-tissue to get the sap nourishment, and also in those nibbling the thin surface cuticle of the leaf, there is much less muscular tension and consequently less need of a strong buttress between mandible thrust and its muscle pull. Hence the frontal surface area is widened and the depth of the infolded adfrons proportionally reduced. When considered in comparison with the line of the epicranial suture and the character of the mandible, the proportions of the frons are good taxonomic characters. We find the shortest frons, the heaviest infolding of the adfrons, the longest epicranial suture associated with strongest mandibles, possessed by the larvae which feed on the edges of the tougher and more fibrous leaves. In the biologically diversified Micro group these structures indicate generic and larger divisions.

THE SETAE.

The setae of the epicranium are considered by Dampf of even more significance than the body setae and to him belongs the credit of giving them proper place in larval descriptions. Dyar in 1896 (4) designated a set of Roman numerals to distinguish the eleven primaries visible from the dorsal side of the head, numbering them from the hind margins forward.

Forbes and Fracker have used these numerals in their references to head setae. Dampf (2), however, has shown that the setae form natural groups within certain areas and has named these groups after the areas upon which they are found. He counts as primaries besides the eleven given by Dyar and Forbes, one seta in the ocellar region, two on the hind part of the gena, and several, generally unhaired tubercles, or "punctures." His system with slight alterations and the addition of a set of symbols to designate the individual seta, is the one adopted here. The following table shows the homology of the system proposed with Dyar's numerals.

In my opinion the 3rd seta described by Dampf among his Dorsolaterals (Dyar's II) does not properly belong there, but should be associated with the small seta near the epicranial suture (Dampf's "vertical" seta), the unhaired tubercle or tubercles between them and the several secondary setae or punctures near the dorsal hind margins. They form a natural and easily distinguished group from the others and, considered apart, give a clearer understanding of the differing setae arrangements. I have

Homology of Epicranial Setae.

AREAS	SETAE	DYAR NUMERALS
Anterodorsal	Ad-1	IX
	Ad-2.	VIII
	Ad-2a (puncture)	
	Ad-3	IV
Ocellar	O-1	
	1a (puncture)	
	O-2	V
	O-3	VII
Subocellar	SO-1	XI
	SO-2	VI
	SO-2a (puncture)	
	Oo-3	X
Lateral	L-1	III
	L-1a (puncture)	
Posterodorsal	Pd-1.	II
	Pd-1a (puncture)	
	Pd-2	I
	Pd-2a (puncture)	
	Numerous secondary punctures	
Genal	G-1	
	G-1a (puncture)	

designated them as the Posterodorsal group, and the 3 forward setae and puncture as the Anterodorsal group. I also place the most lateral of Dampf's Dorso-laterals (Dyar's III) and the puncture (L-1a) on the side of the head near it, in a group by themselves, calling them the lateral group. I think this is justified by the "migration" of the group, which is of great significance; for the approximate distance of L-1 from Ad-3, (as compared with distances separating the different Anterodorsals) in heads superficially alike (tortricid, gelechiid, or oecophorid), not only aids in the separation of such groups, but indicates a different scheme of head development in this particular region. In studying the heads of the Cossidae it was also found that there is a distinct chitinization marking the areas of Anterodorsal, Ocellar and Subocellar groups. That the Lateral seta and puncture fall

behind this chitinization is added indication that they do not belong with the Anterodorsals.

The practically constant proportional differences in length of the epicranial setae in all but the most specialized leaf-mining species coupled with their arrangement into easily definable groups, make it possible for us to homologize the setae and to correlate even the most trifling differences in their positions.

An important fact which is not brought out by Dampf, is that changes in position of the setae are due to modifications by growth or contraction of the chitinous areas upon which they occur. This is shown by the fact that the setae of any given group always remain in that group, and by the relative position of the groups themselves under obviously different and easily recognized changes in the head areas. For example, where there is an enlargement of the head surface there is not a corresponding spreading out of all the head setae, but only of those comprising the Posterodorsal group. We find also in several normally round heads (among most of the free-feeding Micros) a crowding forward of the setae, indicating an enlargement of the posterior part of the head at the expense of the frontal area. The most numerous changes in fact are due to modifications of the epicranium back of the area occupied by the Anterodorsal, Ocellar and Subocellar setae. And consequently, changes in the relative position of the Posterodorsal and Lateral setae are more frequent and striking than among the other groups. In the round feeding larvae of the Lithocolletinae, however, the development is more in the opposite direction, the Anterodorsal, Ocellar, and Subocellar areas are larger in proportion to the Posterodorsal, and there is a consequent spreading out of the setae of the former, the Lateral group is thrust further back and the Posterodorsal group is restricted to a smaller area.

All changes, however, are not confined to group movements. There are also differences in the relative position of the setae within a given group, chiefly differences in distance, but also, among the Anterodorsals especially, in the alignment of the setae. In both the most striking changes are noted among the genera of any given family, but here again we find certain tendencies which aid in the identification of larger groups; for example, Ad-2 and Ad-3 are rather closely approximate in Stenomidae or Oecophoridae, and in the Tortricoidea the three Anterodorsal setae form a very obtuse triangle often, in fact, lying in almost a straight line with L-1, while in other families their alignment tends more towards a right angle.

The positions of the punctures appear at first hand much less constant within families than those of the setae, and offer greater difficulties, for they are often invisible except under the highest

power of a compound microscope. Ad-2a revolves almost completely around seta Ad-2 in the Gelechiidae, and Pd-2a is equally migratory in many groups. I have found, however, no very striking differences among species of the same genus and within families even the tendencies of migration are limited in certain directions. It is never a serious problem to homologize these punctures. The one I have designated as Pd-la offers the most difficulty on account of its frequent proximity to L-1 and Ad-3. That it really belongs with the Posterodorsals and indicates the development of that group is shown in *Gnorrimoschema* and *Nealyda* where it is closely approximate to Pd-2a, lying almost midway between the two primary Posterodorsal setae.

Changes in position of setae and punctures within the setae groups in any given family are most frequent with Ad-2, Ad-2a, O-1, Pd-la and Pd-2a and less frequent with Ad-3, L-la, O-2, and 3, and the Posterodorsal and Subocellar setae. In fact, no group is so nearly uniform in the arrangement and the position of its individual setae throughout the Micros as the Subocellar group.[1]

The secondary tubercles of the Posterodorsal area vary greatly in number and character. In many cases they differ on the two epicranial lobes of the same head and are frequently undistinguishable even under high magnification.

THE TROPHI.

Among the trophi we find our best characters on the labrum and the so-called maxillulae and in the arrangement of the ocelli. On its upper surface the labrum bears twelve primary setae arranged in two symmetrically paired groups of three each (Fig. 1). The outer three are always located upon the area represented on the ventral side of the labrum by the epipharyngial rods (Fig. 2). The development of these rods determining the relative position of the setae, the foremost seta being always at the front extremity. These three setae also have a common nerve connection near the base of the labrum. The three medial setae also form a natural group with separate nerve connections from the laterals. As Forbes' (5) numbering of these setae contradicts their morphology I am proposing the symbols M 1-2-3- for the medial group and L 1-2-3- for the lateral, numbering from the base of the labrum forward. The punctures are treated as subprimaries of the medial group. Fig. 1 shows the homology with Forbes'

[1] Dampf's division of the setae within and below the area occupied by the ocelli into two groups is a convenient one for purposes of description and identification but the name *ocellar* and *subocellar* are somewhat misleading as 0.1 often falls well below the ocelli and SO-2 as frequently within the ocellar area.

numerals. Changes in the larum itself, especially the depth of the median incision, have much to do with alterations in the relative position of the setae, particularly those of the medial group, but in spite of this a characteristic alignment prevails in certain families regardless of the shape of the labrum. This is well illustrated in the Gracilariidae where the arrangement shown in Fig. 1 persists even through the flat stages and in spite of the most radical alterations in the form of the labrum itself. The more common grouping among the Micros is with M-2 laterad and slightly back of M-1.

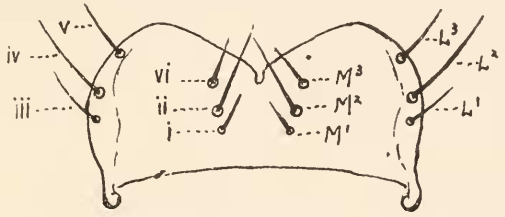

Fig. 1 Dorsal view of a Micro Labrum (Family Gracilariidae) *M-1, M-2, M-3*—Medial setae; *L-1, L-2, L-3*—Lateral setae (Roman numerals show Forbes' numbering of the setae).

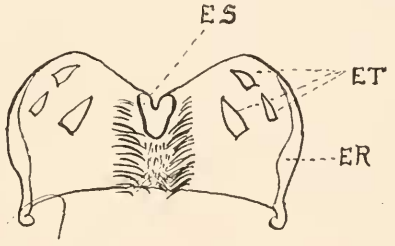

Fig. 2 Epipharynx of a Micro Larva; *ER*—Epipharyngeal Rod; *ES*—Epipharyngeal Shield; *ET*—Epipharyngeal Setae.

Among the Micros the general alignment of the two groups is at least of family significance while slight differences in proportionate distances between setae, and differences in the relative position of the individual setae are of generic value.

Besides the dorsal setae there are two other characters of importance on the labrum; the chitinized epipharyngeal shield in the notch and three pairs of modified setae near the anterior-lateral margin. The shield itself is often quite variable in different species of the same genus and only seems to be generally consistent in the leaf-miners. The epipharyngeal setae are so